**IN THE CLAIMS:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claims 2 and 12-16 have been amended and claims 26-29 have been added as follows:

**Listing of Claims:**

Claim 1 (original): A sensor for determining a characteristic of a target substance, said sensor comprising:

an electromagnetic wave source of supplying an electromagnetic wave;

a photonic sensor element having a photonic crystalline structure and configured to include:

a sensor waveguide for introducing said electromagnetic wave, and

a sensing resonator electromagnetically coupled to said sensor waveguide for resonating the electromagnetic wave of a specific wavelength, said sensing resonator being exposed to an atmosphere including the target substance so as to vary a characteristic of said electromagnetic wave emitted from said sensing resonator; and

a detector configured to receive the electromagnetic wave emitted from said sensing resonator to recognize an intensity variation of the electromagnetic wave and issue a signal indicative of a characteristic of said target substance.

Claim 2 (currently amended): The sensor as set forth in claim 1, wherein

[[sad]] said detector is configured to determine a density of said target substance based upon a characteristic variation of said electromagnetic wave and issue said signal indicative of the density of the target substance.

Claim 3 (original): The sensor as set forth in claim 2, wherein

said photonic sensor element includes within said photonic crystalline structure a reference waveguide; and a reference resonator,

said reference waveguide introducing said electromagnetic wave from said source,

said reference resonator being electromagnetically coupled to said reference waveguide to resonate the introduced electromagnetic waver at said specific wavelength,

said reference resonator being concealed from said target substance,

said detector comprising:

an output intensity meter providing a detection signal indicating an intensity of the electromagnetic wave of said specific wavelength emitted from said sensing resonator ;

a reference intensity meter providing a reference signal indicating an intensity of the electromagnetic wave of said specific wavelength emitted from said reference resonator; and

a density meter comparing said detection signal with said reference signal so as to obtain an attenuation of the electromagnetic wave of said specific wavelength, thereby calculating the density of said target substance based upon said attenuation.

Claim 4 (original): The sensor as set forth in claim 3, wherein

said photonic sensor element has the photonic crystalline structure arranged in a two-dimensional array;

each of said sensor waveguide and said reference waveguide extending within the two dimensional photonic crystalline structure to define an input port and an output port respectively on opposite ends of said waveguide,

each of said input ports being disposed to receive said electromagnetic wave from said source,

each of said output ports being coupled to each corresponding one of said output intensity meter and said reference intensity meter for providing the electromagnetic wave emitted from each corresponding one of said sensing resonator and said reference resonator.

Claim 5 (original): The sensor as set forth in claim 3, wherein

said photonic sensor element has the photonic crystalline structure arranged in a two-dimensional array;

each of said sensor waveguide and said reference waveguide extending within the two dimensional photonic crystalline structure to define an input port and an output port respectively on opposite ends of said waveguide,

said sensing resonator and said reference resonator being disposed respectively within said sensor waveguide and said reference waveguide,

each of said input ports being disposed to receive said electromagnetic wave from said source,

each of said output ports being coupled to each corresponding one of said output intensity meter and said reference intensity meter for providing the electromagnetic wave emitted from each corresponding one of said sensing resonator and said reference resonator.

Claim 6 (original): The sensor as set forth in claim 5, wherein

a plurality of said sensing resonators are aligned along said sensor waveguide.

Claim 7 (original): The sensor as set forth in claim 3, wherein

said photonic sensor element has the photonic crystalline structure arranged in a two-dimensional array;

each of said sensor waveguide and said reference waveguide extends within the two dimensional photonic crystalline structure to define an input port at one lengthwise end thereof,

each of said input ports being disposed to receive said electromagnetic wave from said source,

said photonic sensor element further including a sensing output waveguide and

a reference output waveguide,

said sensing output waveguide and said reference output waveguide extending in parallel with corresponding ones of said sensor waveguide and said reference waveguide, and being electromagnetically coupled respectively to said sensor resonator and said reference resonator, each of said sensing output waveguide and said reference output waveguide defining at its one lengthwise end an output port which is coupled to each corresponding one of said output intensity meter and said reference intensity meter.

Claim 8 (original): The sensor as set forth in claim 3, wherein

said photonic sensor element has the photonic crystalline structure arranged in a two-dimensional array;

each of said sensor waveguide and said reference waveguide extends within said two dimensional photonic crystalline structure to define an input port on one lengthwise end thereof;

each of said input ports being disposed to receive said electromagnetic wave from said source,

each of said output intensity meter and said reference intensity meter being disposed in a spaced relation from a plane of said photonic sensor element and being coupled to each corresponding one of said sensing resonator and said reference resonator to receive the electromagnetic wave emitted therefrom.

Claim 9 (original): The sensor as set forth in claim 2, wherein

said photonic sensor element includes a first photonic crystalline structure and a second photonic crystalline structure which are of different configuration and arranged in side-by-side relation within a two-dimension,

said sensor waveguide comprising:

an input waveguide extending across said first and second photonic crystalline structures;

a first output waveguide extending within a confine of said first crystalline structure;

a second output waveguide extending within a confine of said second crystalline structure,

said sensing resonator being formed within said first crystalline structure;

said second crystalline structure including a reference resonator which causes a resonance of the electromagnetic wave of a wavelength different from said specific wavelength inherent to said sensing resonator;

said detector comprising:

an output intensity meter configured to provide a detection signal indicative of the intensity of the electromagnetic wave of said specific wavelength emitted from said sensing resonator;

a reference intensity meter configured to provide a referenced signal indicative of the intensity of the electromagnetic wave emitted from said reference resonator; and

a density meter configured to compare said detection signal with said reference signal

so as to obtain an attenuation of the electromagnetic wave of said specific wavelength at said sensing resonator, thereby calculating a density of said target substance as a function of said attenuation.

Claim 10 (original): The sensor as set forth in claim 2, wherein

said electromagnetic wave source supplies the electromagnetic wave including different wavelengths so that said sensing resonator allows the resonance of the electromagnetic wave of said specific wavelength which is determined by said target substance,

said detector being configured to select the electromagnetic wave of said specific wavelength emitted from said sensing resonator and calculate the density of the target substance based upon the intensity of thus selected electromagnetic wave.

Claim 11 (original): The sensor as set forth in claim 2, wherein

said electromagnetic wave source is configured to sweep the electromagnetic wave for varying the wavelength thereof with respect to time so that said sensing resonator allows the resonance of the electromagnetic wave of a specific wavelength which is determined by said target substance,

said detector is configured to give an intensity of the electromagnetic wave at said specific wavelength emitted from said sensing resonator and calculate the density of the target substance based upon said intensity of the electromagnetic wave.

Claim 12 (currently amended): The sensor as set forth in claim 10 [[or 11]], wherein

said sensing waveguide is cooperative with said sensing resonator and said detector to define a single detection unit for detection of said target substance of a particular kind,

said sensor including a plurality of said detection units in which said sensing resonators are configured to resonate the electromagnetic wave of the wavelengths which are different from each other for sensing the target substances of different kinds.

Claim 13 (currently amended): The sensor as set forth in claim 10 [[or 11]], wherein

said sensing resonator is provided with a reactor that reacts with said target substance to modify the wavelength of the electromagnetic wave resonating in said sensing resonator for resonating the electromagnetic wave at said specific wavelength.

Claim 14 (currently amended): The sensor as set forth in claim 10 [[or 11]], wherein

said photonic sensor element includes two said sensing resonators,

one of said sensing resonators being provided with a reactor which reacts with said target substance to vary the wavelength of the electromagnetic wave resonating in said sensing resonator,

said two sensing resonators being electromagnetically coupled to give a composite magnetic wave issued to said detector.

Claim 15 (currently amended): The sensor as set forth in claim 10 [[or 11]], wherein

a plurality of said sensing resonators are arranged in the two-dimensional array,

a plurality of said detectors are arranged in a two-dimensional array and coupled respectively to said sensing resonators to obtain the intensity of the electromagnetic wave of said specific wavelength,

said detectors being configured to calculate the density with regard to each of said sensing resonators, giving a density distribution across the array of said sensing resonators.

Claim 16 (currently amended): The sensor as set forth in claim 1, wherein

said electromagnetic wave source supplies the electromagnetic wave of different wavelengths so that said sensing resonator is allowed to resonate the electromagnetic wave of said specific wavelength,

a plurality of said detectors are arranged in a two-dimensional array and coupled respectively to said sensing resonators to obtain the intensity of the electromagnetic wave of said specific wavelength,

said plural sensing resonators being configured to resonate the electromagnetic wave of different wavelengths,

said plural detectors being configured to detect the presence of the target substances of different kinds based upon the ~~intensitys~~ <u>intensity</u> of the electromagnetic waves emitted respectively

from said sensing resonators, thereby giving a two-dimensional distribution of the target substances of different kinds.

Claim 17 (original): The sensor as set forth in claim 2, wherein

said sensing resonator is configured to resonate said electromagnetic wave of said specific wavelength,

a reactor is provided in said sensor waveguide at a portion electromagnetically coupled to said sensing resonator,

said reactor being configured to react with said target substance to alter an effective waveguide length between said sensor waveguide to said sensing resonator to thereby vary the intensity of the electromagnetic wave received at said target detector,

said detector being configured to calculate the density of the target substance based upon the variation of the intensity of the electromagnetic wave.

Claim 18 (original): The sensor as set forth in claim 2, wherein

two said sensing resistors are formed in said photonic sensor element and are electromagnetically coupled to each other,

said sensing resonators being configured to resonate said electromagnetic wave of said specific wavelength, a reactor is provided in an energy coupling path between said two sensing resistors,

said reactor being configured to react with said target substance to alter an effective waveguide length of said energy coupling path to thereby vary the intensity of the electromagnetic wave emitted from said sensing resonators,

said detector being configured to calculate the density of the target substance based upon the variation of the intensity of the electromagnetic wave.

Claim 19 (original): The sensor as set forth in claim 1, wherein

said photonic sensor element includes a first photonic crystalline structure and a second photonic crystalline structure which are different from each other and are arranged in a side-by-side relation within a two-dimensional array,

said sensor waveguide is composed of an input waveguide and an output waveguide which extend in parallel with each other, each of said input and output waveguides extending over the full length of said first photonic crystalline structure into said second photonic crystalline structure,

said sensing resonator being formed in said first crystalline structure between said input waveguide and said output waveguide,

said input waveguide defining at its one lengthwise end away from said second crystalline structure an input port for receiving said electromagnetic wave from said source,

said output guide defining at its one lengthwise end away from said second crystalline structure an output port for emitting the electromagnetic wave of said specific wavelength resonating at said sensing resonator,

said input waveguide being formed with an input reflector at the interface between the first and second crystalline structures for reflecting the electromagnetic wave of said specific wavelength towards said output port,

said output waveguide being formed with an output reflector at the interface between the first and second crystalline structures for reflecting the electromagnetic wave of said specific wavelength towards said input port, each of said input waveguide and said output waveguide being provided with a reactor at a portion bridging across said first and second crystalline structures,

said reactor being configured to react with said target substance to alter reflection efficiency at said input reflector and said output reflector, thereby varying the intensity of the electromagnetic wave received at said target detector, and

said detector being configured to calculate the density of the target substance based upon the variation of the intensity of the electromagnetic wave.

Claim 20 (original): The sensor as set forth in claim 1, further including:

a controller configured to monitor an environmental parameter indicative of an environmental condition,

said controller modifying an optical characteristic of said sensing resonator based upon the environmental parameter to resonate the electromagnetic wave at said specific wavelength.

Claim 21 (original): The sensor as set forth in claim 20, wherein

said photonic sensor element is provided with a heater which is actuated by said controller to modify said optical characteristic of said sensing resonator.

Claim 22 (original): The sensor as set forth in claim 1, further including:

a refresh means configured to eliminate the target substance or impurities trapped on said sensing resonator.

Claim 23 (original): The sensor as set forth in claim 22, wherein

said refresh means is a heater provided on the side of said photonic sensor element to dissipate the target substance or impurities from the surface of said sensing resonator by heat.

Claim 24 (original): The sensor as set forth in claim 1, further including:

modulating means configured to modulate one of wavelength and intensity of said electromagnetic wave supplied from said source to said waveguide.

Claim 25 (original): A method for density detection of a target substance, said method utilizing a photonic sensor element which is configured to include a sensor waveguide introducing an electromagnetic wave, and a sensing resonator electromagnetically coupled to said waveguide for resonating said electromagnetic wave of a specific wavelength,

said method comprising the steps of:

exposing said sensing resonator to an atmosphere including the target substance;

introducing the electromagnetic wave including said specific wavelength through said sensor waveguide;

detecting an intensity of the electromagnetic wave resonating at said sensing resonator; and

analyzing said intensity to calculate a density of said target substance.

Claim 26 (new): The sensor as set forth in claim 11, wherein

said sensing waveguide is cooperative with said sensing resonator and said detector to define a single detection unit for detection of said target substance of a particular kind,

said sensor including a plurality of said detection units in which said sensing resonators are configured to resonate the electromagnetic wave of the wavelengths which are different from each other for sensing the target substances of different kinds.

Claim 27 (new): The sensor as set forth in claim 11, wherein

said sensing resonator is provided with a reactor that reacts with said target substance to modify the wavelength of the electromagnetic wave resonating in said sensing resonator for resonating the electromagnetic wave at said specific wavelength.

Claim 28 (new): The sensor as set forth in claim 11, wherein

said photonic sensor element includes two said sensing resonators,

one of said sensing resonators being provided with a reactor which reacts with said target substance to vary the wavelength of the electromagnetic wave resonating in said sensing resonator,

said two sensing resonators being electromagnetically coupled to give a composite magnetic wave issued to said detector.

Claim 29 (new): The sensor as set forth in claim 11, wherein

a plurality of said sensing resonators are arranged in the two-dimensional array,

a plurality of said detectors are arranged in a two-dimensional array and coupled respectively to said sensing resonators to obtain the intensity of the electromagnetic wave of said specific wavelength,

said detectors being configured to calculate the density with regard to each of said sensing resonators, giving a density distribution across the array of said sensing resonators.